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GEN IV International Forum
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The United Kingdom re-joins GIF at a historic time for advanced nuclear development and international climate change action plans

First of all, a big thank you to Gilles Rodriguez for giving me the unexpected honour of guest editor of the February/March issue of the GIF Newsletter at a pivotal time for world nuclear energy development.

The UK re-joined GIF early in 2019 and were invited to attend the Vancouver GIF Policy and Expert Group meetings in May 2019 which was held at the same time as the Clean Energy Ministerial 2019 with both meetings discussing the role nuclear energy can play in meeting the urgent climate change challenges. Who could have predicted then what was going to happen over the next 18 months! Following the Weihai meetings in the Autumn we have successfully transferred all our GIF business to online platforms and all learned a 'new' way to engage with International friends and collaborators. Hopefully we will all be able to physically meet sometime soon. The UK representatives to the SFR and VHTR systems, working groups and task forces are looking forward to meeting with you all in person to share the exciting prospects for advanced nuclear energy.

Since the last EG and PG meetings in October 2020, significant progress is underway in the UK following publication of the UK Governments Energy White Paper and the '10 point plan' supporting the green industrial revolution, more of which later in the newsletter.

The UK is continuing to present project proposals for engagement with the SFR and VHTR Project Arrangements and will be seeking formal agreement from the other partners to join these arrangements as soon as possible. A big thank you to all those coordinating this approval process and the hard work supporting the UK's wider engagement with GIF's exciting agenda. On financing of nuclear energy we are delighted that Fiona Reilly is leading on a white paper that will identify the barriers to private sector investment and recommendations on the changes required to remove these barriers. This will help realise the potential of advanced nuclear systems to meet the wider world energy demands and decarbonisation agenda flexibly and alongside other low carbon energy production. The challenges are great but the rewards will be even greater!

Here in the UK, the Nuclear Innovation Programme continues with research and innovation investments focused in enabling advanced nuclear technology to play a role in our net zero commitments. This includes but is not limited to materials, fuels, fuel cycles, reactor designs and regulatory readiness.

In closing, I would like to thank you all for your warm welcome of the UK back into the GIF family. We are excited to be back, for the future of nuclear and in our engagement with all of you.

Dr Fiona Rayment

Chief Science and Technology Officer, National Nuclear Laboratory and UK representative of the GIF Policy Group

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Major events

The 10th International Symposium on Supercritical Water-Cooled Reactors

March 15–19, 2021
Prague, Czech Republic, EU

ISSCWR-10

For further details, go to
www.gen-4.org

The Energy White Paper and the Role of Advanced Nuclear

- **Dr Nicholas Barron**, Technical Lead for Fast Reactor Fuels, National Nuclear Laboratory and UK GIF representative on SFR System Steering Committee (SSC)
- **Caroline Longman**, UK Government Account Director, National Nuclear Laboratory

Recognising the reality that the climate emergency is already upon us, in 2019 the UK became the first OECD nation to legislate to bring all greenhouse gas emissions to net zero by 2050. The scale of the challenge to meet this legislation is staggering and is well articulated in the report "The Missing Link to a Liveable Climate[1] ". For the UK to replace its current usage of oil with hydrogen would require covering an area of 136,000km^2 with offshore wind or 26,000km^2 with solar panels. This compares with just 55km^2 of advanced reactors. (referred to as 'Advanced Heat Sources' in the report).

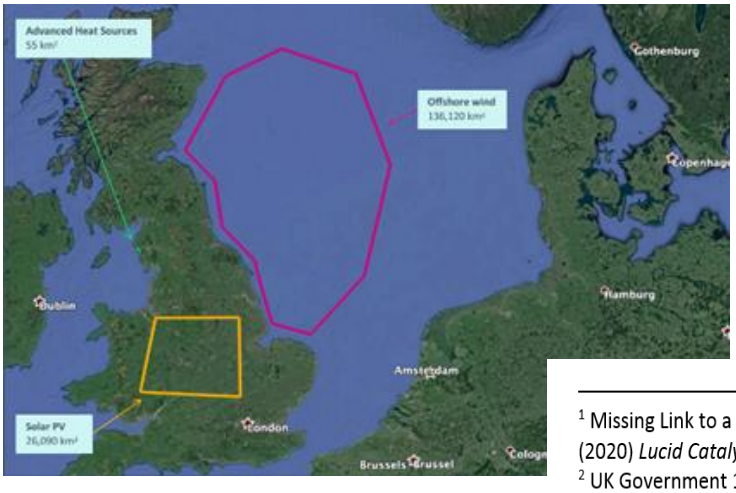

Figure 1 Comparing the Total Area required to replace UK's current oil consumption with hydrogen generated from wind, solar or advanced reactors[1]

In the wake of the Coronavirus crisis, the UK government published the "10 Point Plan[2]", to support a green industrial revolution. Each of the elements of the 10 Point Plan targets a different aspect of a future green economy, from decarbonising aviation to driving the growth of low carbon hydrogen.

The plan indicated that nuclear power is expected to play a major part in the UK's net zero economy. This includes public funding to a research and development programme on advanced reactors, specifically Generation IV-type systems. With a further commitment to build a demonstrator in the UK by the early 2030's.

Like most nations, the greatest decarbonisation challenge in the UK is fossil fuel use for transport, industrial processes and space heating which together, account for over 70% of the country's greenhouse gas emissions. The 10 Point Plan points to the likely role that Advanced Nuclear could play in net zero. It also recognised that high grade heat from Advanced Reactors could help unlock a hydrogen economy; through efficient hydrogen and synthetic fuel production. Late last year, the Energy White Paper[3] built upon the commitments made in the 10 Point Plan. Setting out plans for future legislation and further cementing the commitment to Advanced Nuclear.

The UK government's National Nuclear Laboratory and partner organisations are developing the understanding of how advanced reactors can support a hydrogen economy in the UK. The work includes development of a roadmap to deploy coupled reactors and hydrogen production technologies, identifying key research and development challenges that need to be met. The challenge is the timescale, as set out by the Energy White Paper; requiring demonstration by 2030 and commercial deployment by 2050. This can only be achieved through international co-operation and mutual objectives. The UK's membership of GIF is a key component of the strategy to accelerate the deployment of advanced systems, through collaborative and co-operative research and development to support efficient and economic decarbonisation of electric and non-electric energy.

[1] Missing Link to a Livable Climate: How Hydrogen Enabled Synthetic Fuels Can Help Deliver the Paris Goals (2020) *Lucid Catalyst, Kirsty Gogan and Eric Ingersoll*

[2] UK Government 10 Point Plan https://www.gov.uk/government/publications/the-ten-point-plan-for-a-green-industrial-revolution

[3] UK Government Energy White Paper, Powering our Net Zero Future https://www.gov.uk/government/publications/energy-white-paper-powering-our-net-zero-future

Advanced Nuclear Reactors and the UK Hydrogen Economy

- **Dr Nicholas Barron**, Technical Lead for Fast Reactor Fuels, National Nuclear Laboratory and UK GIF representative on SFR System Steering Committee (SSC)
- **Dr Dave Goddard**, Fellow in Fuel Manufacturing, National Nuclear Laboratory and UK GIF representative for the SFR Advanced Fuels PMB
- **Caroline Longman**, UK Government Account Director, National Nuclear Laboratory



The civil nuclear sector is currently the largest single low carbon source of electricity in the UK and is synonymous with the delivery of baseload electricity to the UK grid and supporting high quality jobs as part of the clean energy economy[1]. It will continue to play a critical part in the future clean electricity system as the UK moves to deliver net zero greenhouse gas emissions by 2050.

The Committee on Climate Change, the independent advisory body on reaching net zero in the UK, predicts that in addition to a large increase in baseload electricity, a net zero UK energy system will also require 270 TWh of hydrogen by 2050[2]. This will require the UK to create a hydrogen economy that is the same size as the total amount of electricity it currently uses. Currently, hydrogen production relies on fossil fuel based Steam Methane Reforming for the majority (~80%) of demand, with electrolysis supporting the remaining. Producing hydrogen in bulk from renewables and electrolysis alone would be expensive and require challenging build rates. Electricity from nuclear reactors can also deliver hydrogen through conventional electrolysis and could make a significant contribution to help realise a near term hydrogen economy. A longer term opportunity is associated with the direct use of heat from Advanced Nuclear Reactors. Advanced reactors could produce heat at temperatures above 500°C, potentially enabling reactor concepts to drive thermochemical water splitting cycles or higher efficiency steam electrolysis. Thermochemical processes could enable the efficient production of large amounts of hydrogen with zero greenhouse gas emissions and the IAEA has conducted economic modelling which suggests that these methods could deliver hydrogen at a cost of $2/kg[3].

A specific example of how an advanced reactor concept could contribute to a net zero UK energy system has been identified by both the Energy Systems Catapult (ESC)[4] and the Nuclear Innovation and Research Advisory Board[5] (NIRAB). In this, the ESC report "Innovating to Net Zero[6] " concluded that "across a range of cost assumptions, deployment of High Temperature Gas Reactors (HTGR's) looks favourable, with an annual production of 50-100 TWh of hydrogen in the UK". The NIRAB report "Achieving Net Zero, the Role of Nuclear Energy in Decarbonisation[7]" recognised HTGRs as having the potential to deliver in time to meet the UK's net zero needs. Through operation of the existing fleet of nuclear reactors, the UK has the skills, technical expertise and infrastructure base to support the development of these systems, including investment by UK government in an ambitious programme of fuel cycle research and development to enable rapid deployment of these systems.

The UK is supporting research through the "Nuclear Innovation Programme", to establish the skills and capabilities necessary to support advanced reactors. In order to achieve success in the necessary timescales for net zero, international partnership and co-operation is vital. The UK's membership of GIF is recognition of the importance of international collaboration to enable cost efficient nuclear deployment in the timescales that can enable nuclear to play a major part in UK's net zero future.

[1] *Nuclear Industry Association (2017), Nuclear Activity 2016*
[2] *Committee on Climate Change (2019), Net Zero, The UK's Contribution Stopping Global Warming*
[3] *Examining the Techno-economics of Nuclear Hydrogen Production and Benchmark Analysis of the IAEA HEEP Software (2018) IAEA-TECDOC-1859*
[4] *Energy Systems Catapult, https://es.catapult.org.uk/*
[5] *Nuclear Innovation and Research Board, https://www.nirab.org.uk/*
[6] *Energy Systems Catapult, (2020) Innovating to Net Zero*
[7] *Nuclear Innovation and Research Board, (2020) Achieving Net Zero, the Role of Nuclear Energy in Decarbonisation*

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The 2021 GIF targets as seen and shared by the Policy and the Technical Secretariats

Recently the 2021 objectives were defined and harmonized between the Technical Director, the Policy Director and the OECD Technical Secretary. For an efficient GIF management we wanted to position limited but clear objectives for 2021. They are presented below.

The Technical Director (**Gilles Rodriguez**) defined eight major axes to look after in 2021:

- Achieve the **Molten Salt Reactor (MSR) organization** into a **System Steering Committee**
- Realise a comprehensive connection between **MSR group members** and **Safety** Working Group
- Confirm the launching of the **NEANH initiative (N**on-**E**lectrical **A**pplication of **N**uclear **H**eat**)**
- Complete initiated actions: **R&D Infrastructure** final report and **PR&PP** white papers
- Confirm the **Advance Manufacturing & Materials Engineering** Task Force new organization in several subtasks (AMME TF)
- Define a clear GIF organization and vision dedicated to a **better and smarter connection with the private sector**
- Pursue the **Education & Training WG successful story** with some extension towards young researchers, Knowledge Preservation of retired experts and go with any initiatives
- Define our **communication strategy:** general (Web, Newsletter, videos, …) and scientific (World Nuclear Exhibition event, Publication plan, Improve our Annual Report)

The Policy Director **(Nobuchika Kawasaki),** defined eight targets for 2021:

1. **Clear GIF future direction:** GIF mission white paper
2. **Strong Expert Group leads:** Generation IV Forum Orientations for 2021 from the Tech Dir.
3. **Vision for Reactor developments:** Planning & reactor vision 2030
4. **Common Methodologies:** Generalize as worldwide methodology (+ Classified evaluation results)
5. **Strategic connection with GIF outside partners as GIF reliance:**
   Selection of strategic items for cooperation (Mutual beneficial relationship)
   Small Group discussion, Special events/workshops
6. **Strategic information release:** After important events/actions
7. **Next GIF leadership organization for 2022-2024:** New GIF Policy Group chair
8. **Stable and sustainable Tech. Secr. support & PG/EG administration:** All GIF organizations supported by TSs

The Head of the Technical Secretariat **(Philippe Guiberteau)** will assume and enhance the **GIF Technical Secretariat (GIF TS)** through 6 principal axes:

- **Stabilize and reinforce GIF Technical Secretariat organization**
- **Enhance GIF Technical secretariat work**
- **Improve GIF TS coordination and support to GIF board**
- **Develop links and crosscutting subjects inside GIF and with OECD NEA divisions** for example: 1/ **Inside GIF:** PRPP white paper finalization, Safety (MSR and RSWG), NEANH (all). 2/ **Between GIF and NEA:** Fuel Cycle with NEA Science Division, Advance reactor and Manufacturing in Nuclear Innovation 2050, IFNEC….
- **Improve GIF links with industry and other non-profit international organizations: i.e.** exchanges and collaboration with WNA, organizing a specific "GIF forum" with industrials
- **Continue to develop GIF communication** (technical, external and internal). In partnership with OECD/NEA, GIF TS will continue to improve the contents and style of our GIF website.

Concerning Covid pandemic, more than ever, we all look forward to returning to normality, being able to meet face to face and have in-person technical exchanges. Well ahead of this, GIF TS remains proactive.

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Newcomers in GIF : Geordie and Frédéric

Dr Geordie GRAETZ is an experienced government relations, corporate affairs, and stakeholder engagement professional with extensive knowledge of the nuclear, energy, and mining sectors. As Government and International Affairs Advisor in the Office of the CEO at ANSTO, he leads engagement with the Australian Government on energy portfolio and radioactive waste management policy matters. He also represents ANSTO in multilateral and international forums and promotes the Organisation's reputation in the Asia-Pacific through his management of key bilateral relationships. Geordie previously led community consultation activities on the South Australian Nuclear Fuel Cycle Royal Commission Report, having been on the staff of the Royal Commission, and is an expert on public participation, community engagement, and consent-based siting processes for the establishment of nuclear fuel cycle facilities and activities. He is the Chief Scientific Investigator for Australia's involvement in the International Atomic Energy Agency's (IAEA) Coordinated Research Project on the Economic Appraisal of Small Modular Reactor (SMR) Projects: Methodologies and Applications; is Vice-Chair of the OECD–Nuclear Energy Agency's Expert Group on Uranium Mining and Economic Development; and is a consultant to the IAEA's INPRO Collaboration Project Study on Cooperative Approaches to the Back End of the Nuclear Fuel Cycle. He also is a member of the International Framework for Nuclear Energy Cooperation's Reliable Nuclear Fuel Services Working Group. He has been awarded by the International Association of Public Participation (IAP2) on three occasions, is the co-editor of the book, 'Mining in the Asia-Pacific: Risks, Challenges and Opportunities', and has numerous publications on risk, human rights, political economy, and the extractive industries. Geordie holds a Doctorate and a Graduate Certificate in Mineral Resources (Sustainable Development) from The University of Queensland. Through his doctoral studies, he pioneered a framework to guide companies' community engagement activities and communications. He also holds a Master of Arts (Political Theory) and Bachelor of International Studies with First Class Honours from The Flinders University of South Australia, as well as a Certificate of Chinese Language from the Chinese Language Division of National Taiwan University.

Geordie is based in Sydney and lives with his partner, Keith, a marketing professional. He is a fan of chocolate, gyms, cats, rainbows, street art, cars, travel, architecture, K-dramas, and ceramics.

"*As for what I would like to get out of my participation in the **EMWG (Economic Modelling Working Group),** I'm hoping to be able to gain economic and financial information that will assist in the Australian Government's understanding and consideration of advanced reactor designs – should it wish to adopt nuclear energy technology in future. I'm also hoping to be able to contribute to methodological discussions and development; share knowledge and insights that I can from my role in the new IAEA CRP on the Economic Appraisal of SMRs; and bring a broader, but also unique, analytical lens to the work of the Working Group based on my understanding of socio-political factors.*"

Dr Frédéric NGUYEN graduated as an engineer from the École Centrale Paris (1988). He obtained his Master in Astrophysics in 1989, his PhD in Astrophysics in 1992, his Habilitation (HDR) in 2018 and was nominated Senior Expert at CEA in 2019. He has co-authored 98 papers in journals (H-factor = 19).

Dr Frédéric Nguyen has been working for the last 30 years in physics modeling, numerical simulation and experiments for nuclear energy at CEA.

He started his career in the field of magnetic fusion in 1989. He was physicist on the Tore Supra tokamak (France, 1989-2002), associated staff at the Joint European Torus Joint Undertaking (1994-1995, U.K.), scientific coordinator for EDFA-JET in the task force H (2000-2002), visiting scientist and responsible for the collaboration with the Association Euratom- Max-Planck Institut für Plasmaphysik (Germany, 2000-2002). He contributed to technical and physics studies for ITER (H & CD, PACTITER) and served as CEA expert in the European Coordinating Committee on Fast Wave Heating and Current Drive (1996-2002).

Dr Nguyen has been working in the field of fission energy since 2002. He worked on the contamination of primary circuit of nuclear reactors (PACTOLE, PACTITER and OSCAR codes, 2002-2009). He served as laboratory head (2004-2009) and deputy division head (2009-2012) in the Nuclear Technology Department. He was in charge, for CEA, of the collaboration between EU and China on severe accidents (ALISA project, 2012). He became physicist in the Reactor Study Department in 2012, working on neutronics and fuel cycle. He was responsible for the development of neutronics numerical tools for fuel cycle in the CEA SIMU/SINET project (1996-2020). He is currently working in fuel cycle, non-proliferation and nuclear forensics. He serves at the Bureau de Normalisation d'Equipements Nucléaires (BNEN), GT6 commission, as expert in SG1 (Analysis and measurements in nuclear reactors) since 2019.

Frédéric will represent France in the **PRPP** Working Group (Proliferation Resistance & Physical Protection) replacing Eric Hervieu. Thank you Eric for your contribution and welcome Frédéric.

SHARE YOUR NEWS ? Our GIF Newsletter is here to talk about your projects, if you have anything you wish to share please contact us.